EFFECTS OF MATERNAL EDUCATION ON IMMUNIZATION ADHERENCE AMONG UNDER FIVE CHILDREN IN BUNGOMA COUNTY

By

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Declaration

This research paper is my original work and has not been presented for a degree in any other university.

Signed…………………………………………… Date …………………………………………...

Kuloba Nasimiyu MaryBennah

This research paper has been submitted for examination with my approval as a university supervisor.

Signed………………………………………… Date ………………………………………….

Dr. Mercy Mugo

Dedication

To my parents-Mr Ferdinand Kuloba and Mrs Judith Wafula Nangekhe Kuloba

Acknowledgement

I am greatly indebted to my supervisor, Dr. Mercy Mugo, who made this research an excellent learning process through her valuable comments, advice and guidance.

My word of gratitude goes to my family and friends for their immense support in different ways. First to my family Brian, Benedict and Bramwell and to all my friends for their support, friendship, words of encouragement and prayers.
Above all, I would like to thank God for the gift of good health, wellbeing and successive accomplishment of the theisis without any hitches.

However, neither the above-named persons, institutions nor the University of Nairobi should be held responsible for mistakes or views of this paper; I bear the sole responsibility

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[1] Katholischer Akademischer Auslander-Dienst- Catholic Academic Exchange Service

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List of abbreviations

BCG   Bacillus Chalmette–Guerin

DHIS   District Health Information Systems

DTP1   First dose of diphtheria toxoid, tetanus toxoid and pertussis vaccine

DTP3   Third dose of diphtheria toxoid, tetanus toxoid and pertussis vaccine

GIVS   Global Immunization Vision and Strategy

GVAP   Global Vaccine Action Plan

GPI   Global Polio Initiative

HepBb   HepB birth dose

HepB3   Third dose of hepatitis B vaccine

Hib3   Third dose of Haemophilus influenza type B vaccine

PCV3   Third dose of Pneumococcal Conjugate

Pol3   Third dose of polio vaccine

Rcv1   First dose of Rubella Containing Vaccine

Rotac   Rotavirus last dose

UNICEF   United Children's' Fund

VPD   Vaccine preventable diseases.

Abstract

The countdown to 2030 aims at monitoring progress towards achieving healthy lives and promoting prosperity for all ages of the population. The countdown has mainly focused on measuring evidence-based interventions across continuum of care from antenatal to postnatal care. Globally, countries are aligning themselves towards achieving the global countdown; Kenya has not been left behind. The country has made immense progress in increasing coverage of basic vaccines. However, despite this, there is still reported a high number of unimmunized children among under-five children. Prediction of immunisation coverage rate indicates a downward trend for basic vaccines. In addition to that, existing regional disparities in coverage and inequities on immunization within the country have contributed immensely to recurring problem. In view of this challenge, the study sought to find out effects of maternal education on immunization adherence in Bungoma County. The study employed cross-sectional county-level data from MICS, 2014 for Bungoma County to analyze immunization adherence. The study employed probit regression model to estimate Polio and DTP immunization adherence among under-five children. Results indicated mother's age at birth significantly impacted on immunization adherence for DTP and polio but in a negative way. Mother's education, Mother's age at first birth, birth oder of the child and household wealth index are statistically significant to immunisation adherence both DTP and Polio. In view of the findings, the study implicates the need to educate women on importance of immunisation beyond the classroom knowledge. Finally, the findings suggest needing to design policies that promote utilisation of public health intervention at community level which can be easily be understood and embraced by the community.

CHAPTER ONE: INTRODUCTION

1.1.0 Background of the Study

Immunisation as a basic human right, is an act of making an individual resistant to infection. The sustainable development goals (SDGs') recognize immunization as an essential ingredient for healthy lives.

1.1.1 Global commitments on Immunisation

Immunization coverage provides a monitoring framework for the realization of global and national goals commitments. The global commitments emanate from the Vaccine Alliance (GAVI), Millennium Development Goals (MDGs'), Sustainable Development Goals (SDGs') and Universal Health Coverage (UHC). They focus on achieving zero under-five morbidity and mortality. Kenya subscribes to these agenda being a member country under the UN Convention.

GAVI has been in the forefront in advocating that no child is left behind in accesing vaccines as they need to live healthy and successful lives (GAVI, 2015). Through their global efforts, the Alliance has prevented more than 13 million deaths in developing countries while child mortality has been halved largely through immunization (GAVI, 2019).

MDG's era was marked by an incredible decrease in mortality and morbidity among women and children between 2000 and 2015. The SDGs' provides a much broader structure on reproductive, maternal, newborn and child health (RMNCH). RMNCH has been incorporated in three of the 13 targets of SDG for health and in various targets in the other 16 SDGs.

The major purpose of UHC is to assist in the minimization of persistent differences in RMNCH within and between nations. According to Boerma et al., (2018), household surveys provides data on coverage inequalities and trends for comparison within and across countries. Evaluation of inequalities and progress across RMNCH continuity of care provides a baseline to determine coverage and equity in the mode of utilizing health services. They include interventions like reproductive health, maternal and newborn care, immunisation and management of child illness (Osgood, 2015).

1.1.2 Global Efforts on Immunisation coverage

Immunization provides a solid platform that brings children and families into contact with primary health services five or more times through the first year of a child (1YOF) (Philippe et al., 2009; Machingaidze et al., 2015; GAVI/UNICEF, 2018).

As the GAVI[2] supported countries shift attention to strengthening routine coverage and introduce new vaccines, recurring diseases outbreaks is an endless reminder that countries commitment to immunization is key in stimulating wellbeing for all at all ages and in achieving healthy lives.

The key strategic objectives have been documented by the GVAP with aims of advancing coverage and equity for both target geographic areas and population groups with low vaccination coverage, focusing on programmatic issues such as supply chain management, data quality and use, sustainable financing (Bilous et at., 2006).

The Global Vaccine Action Plan the Strategic Advisory Group of experts on Immunisation (SAGE) recognizes that countries are on course in achieving global targets on immunization set for 2015. The goal aims at strengthening entry of new and under- used vaccines. In addition to that, efforts have been geared towards improving coverage of routine vaccines such as DTP3, polio, maternal and newborn tetanus, measles and rubella. In addition countries such as Indonesia, Nigeria and Ethopia have made significant advancement to strengthening DTP3 coverage. Nigeria has also intensified its' efforts towards polio elimination.

Health systems support mechanism that facilitates immunization includes the supply chain, cold storage, disease surveillance, trained healthcare staff, data monitoring and use and community outreach which contribute to more responsive primary healthcare delivery.

Immunization services have been integrated with other public health intervations. It provides an expansive platform to reach communities with additional health intervention including nutrition and integrated case community management (iCCM)

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[2] Gavi supports the world's lowest-income countries. Eligibility for Gavi support is determined by a country's Gross National Income (GNI) per capita according to World Bank data.

trough neonatal, post- natal and maternal healthcare to sexual and reproductive health and education (UNICEF, 2017).

Resilient health systems provide a platform to scale up and provide new vaccines, improve coverage and equity, and improve the delivery of other essential health services (GAVI, 2018). In emergency context, health systesm and services are robust to ensure that under – five children affected by conflicts, natural disasters and disease outbreak are immunized (WHO, 2015).

There has been significant investment made by the GPI through RIAs' and SIAs' demand generation, monitoring and evaluation, surveillance, capacity building of personnel and enhacing efficiency in purchase and supply of vaccines (Cochi et al., 2016; GAVI, 2011).

The WHO's African region trends have been improved through the adoption of the regional specific efforts and the region's EPI strategic plans of action during the periods (2001-2005 and 2006-2009) by using the RED[3] approach (Machingaidze et al., 2015; Mihigo et al., 2015; Ryman et al, 2009).

Therefore, these regional strategic agendas deliver action plans to countries on adopting new technologies and vaccines, improving immunization coverage, and the provision of health interventions (Machingaidze et al., 2015; Perry et al., 2015; UNICEF, 2005; Wolfson et al., 2008).

1.1.3 Global and Regional Immunization Coverage

Globally, there has been a noticeably decline in the number of unimmunized under – five children by 1.8 million from 2010 to 2017 (WHO, 2018). Despite the progress made, approximately 19.9 million children were not immunized in 2017 (WHO, 2018), additionally, two of the six GAVI supported regions have reported outbreak measles, 11 countries failed to achieve DTP coverage by 90% in 2017 compared to their performance in previous years and three regions have experienced vaccine-derived poliovirus (GAVI, 2018). As a result, vaccine-preventable diseases among under-five children have contributed approximately 30% mortality. Although immunization coverage across African has improved significantly over time, coverage rates across

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[3] RED approach – Reach Every Child approach is a strategy which aims to achieve 80% immunization coverage in all districts and 90% nationally in the WHO member states.

countries are below national targets, with many rates plateauing or decreasing further (Figueiredo & Were, 2019).

As shown in figure 1.1, developed countries have been able to achieve and sustain global goals on immunization. This has been attributed to countries commitment in ensuring that every child is immunized and communites understands the importance of immunization.

In developing countries, despite the gains made in immunisation, there is still high number of zero dose and under immunized under – five years old children who are still vulnerable to infectious diseases (WHO,2013). A review of MDGs showed that sub-Saharan Africa (SSA) countries did not achieve the MDGs targets on reduction of maternal mortality and children mortality under-five years old by two-thirds (33 per 1000 live births) and three-quarters (147 per 100,000 live births) respectively in comparison to the global data (Afnan et al., 2015; Kanyuka et al., 2016). This is as a result of unresponsive uptake of new vaccines and failure to sustain routine immunization activities despite investment made from countries and partners (Machingaidze et al., 2015; Perry et al., 2015; Kanyuka et al., 2016; Gurmu & Etana, 2016).

Figure 1. 1Trends in immunization coverage
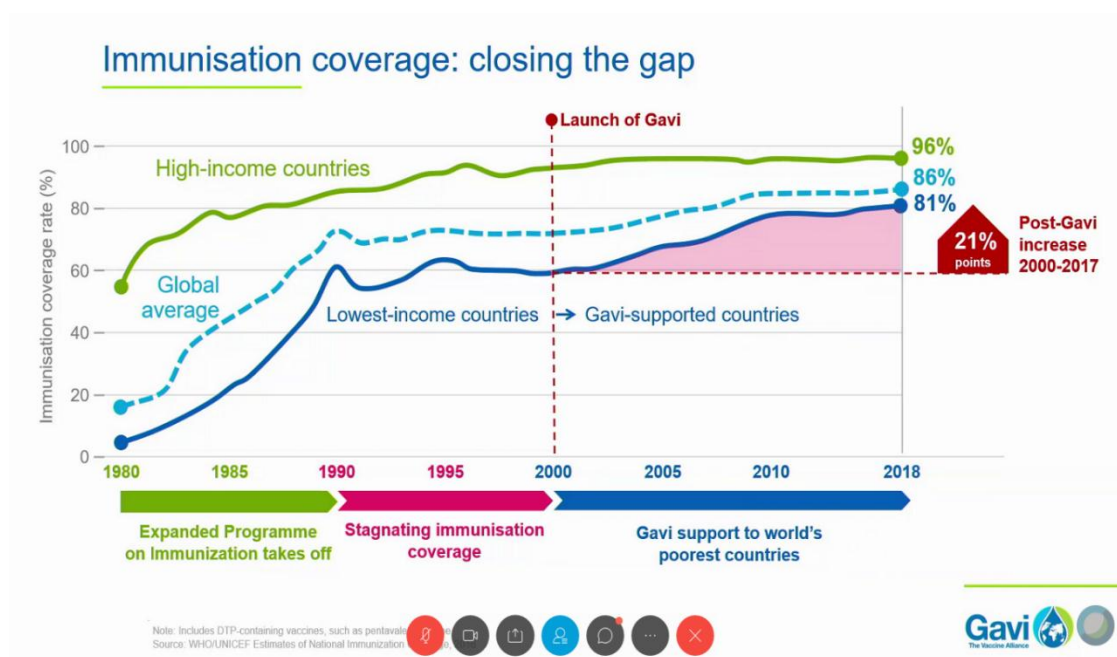
Source: Gavi, 2018

Currently, countries are now working towards the SDGs, under the mantra of *"leave no one behind",* with much emphasis on health systems strengthening in achieving the UHC agenda (WHO, 2017).

In view of these consistent challenges, the study emphasizes on investing in primary care givers and continued monitoring of immunization trends, identify disparities, and provide solutions. Immunization is an essential ingredient of primary health care. Routine immunization benefits the less fortunate and underserved population, including many in hard to reach areas and in creating it as one of the most equitable health interventions (GAVI, 2017). Therefore, GAVI is supporting countries to strengthen their routine immunization by systematically addressing inequities including gender-related, geographic and socioeconomic GAVI (2018).

Achieving zero elimination of poliovirus has become an uphill task, with reported vaccine-derived poliovirus in parts of Papua New Guinea, the Syrian Arab Republic, DRC, Nigeria and Somalia from 2017 to 2018 (Tevi et al., 2016; Cochi et al., 2016; Etsano et al., 2015; GVAP,2018).

1.1.4. WHO position on immunisation.
WHO recommends the following antigen to be given to children below five – years.

1.1.4.1. BCG

This antigen is administered against tuberculosis especially in countries with high occurrence of TB and Leprosy. WHO (2018), states that a single dose of BCG should be given at birth to neonates failure, to which should be given at the earliest time possible.

1.1.4.2. DTP

Strong immunity against pertussis can be achieved as a result of early immunization during the first year due to the disease's severity. The first dose is given at birth, second doses at least 4- weeks, while the third doses completed at the sixth month. However, missed or delayed doses should be given as soon as possible with a 4 weeks interval. This could be given alongside IPV, hep B, and Hib in order to reduce number of injections (WHO, 2017).

1.1.4.3. Polio

This infectious disease that casues paralysis among under - five years children. It is transmitted through contaminated water or food or contact with an infected person. WHO states that children under five - years should be vaccinated against poliovirus with a complete of 4 doses. In regions with reported high incidences of this infectious disease, the birth oral polio vaccine (BOPV) dose should be provided by following a series of 3 BOPV doses and minimal of 1 IPV dose (WHO, 2016).

1.1.4.4. Measles

This infectious viral disease is the leading causes of VPD among under-five children. WHO recommends that MCV1 should be administered to everyone at risk both children and adult due it is cost-effectiveness. Strengthening routine immunisation systems is key in reducing the cost associated with SIAs and treatment of measles. Introduction of MCV2 has seen global coverage increased to 62% (GVAP, 2018) to cater for zero doses and undermimunised. MCV1 is administered at 9 months. In order to achieve optimal immunity of MCV1, early administration during FOY is recommended (WHO, 2017).

1.1.4.5. Tetanus

This bacterial disease is one of the leading childhood morbidity and mortality that is caused by toxigenic strains of bacterium. Therefore, WHO recommends the elimination of bacterium through the utilization of antigen. In order to sustain high coverage, 6 doses of TTCV should be administered through the normal childhood immunization activities within at least 4 weeks interval (WHO, 2017).
Other new vaccines that have been introduced and recognized by WHO include rotavirus, whooping cough - whole-cell Pertussis, pneumococcal conjugate and Hepatitis B vaccine (WHO, 2015).

1.1.5 National efforts towards immunisation coverage

Kenya has made extensive efforts in preventing morbidity and mortality caused by infectious diseases. The country has prioritized key health indicators in its Big 4 agenda over the next 5 years (GoK, 2017). Immunization is critical to achieving this

agenda. It is recognised as a basic right as defined by the Kenyan constitution. In addition to that, the extension program on immunisation has introduced several new vaccines into routine immunisation schedule over the past 13 years to strengthen the gains made and reach more children with life-saving vaccines.

Health services are provided through two levels of government; a national government whose responsibility is mainly focused on providing leadership in policy development, capacity development and management of referral facilities. At the county level, the focus has been on service delivery. Kenya Health Policy determines health services and interventions provided at each level of care as stated in the following levels;

a) Community-level: This is the backbone of service delivery creating demand and supply of services (health promotion services);

b) Primary level: It is the first point of contact linking health sector and patients. It comprises of dispensaries, health centres, maternity and nursing homes in the country;

c) County-level: Services provided here complement primary care level for a comprehensive package based on clients' needs;

d) National level: This is composed of mainly the national and teaching referral hospital.

The government has demonstrated its commitment to achieving coverage and equity by the ratification of international policy on immunization, developing and implementation of immunisation guidelines to the Kenyan context.

This can be seen through development of various policy documents and ratification of international treaties and agaenda.

1.1.5.0 Kenya National Policy and Planning

1.1.5.1 Kenya Health Policy (2014-2030)

This policy of 2014 up to 2030 provides a framework on health commitments made in the country in line with the global and regional commitment. It recognizes health as basic human rights and contribution to economic development. To reach this goal, the policy aims to provide affordable, equity and quality health at the best achievable values to all Kenyans.

1.1.5.2 Kenya Health Sector Strategic Plan 3

This strategic plan (KHSSP-III) provides medium-term action for health services and investment in Kenya. This is for the period 2012 – 2017 and states the intent of the government towards achieving national and global commitment.The strategy is plugged in by the Kenya Vision 2030, Health policy (2014-2030), Kenya constitution 2010 and other global health commitments of the country.

1.1.5.3 Extended Program on Immunisation (EPI)

The EPI provides guidelines for the management and administration of vaccines. Apart from the routine infant vaccines, the unit also provides vaccines for high risk groups (Tetanus for special occupational risk groups, Hepatitis B vaccines for health workers, typhoid vaccine for food handlers and yellow fever vaccination for foreign travelers) and emergency vaccines (anti-rabies vaccine, snake venoms and any other emergency vaccines) as may be prescribed during outbreaks. The role of the EPI program focuses on policy regulation and evaluation, commodity security and quality assurance, monitoring and evaluation, advocacy and resource mobilization, capacity strengthening and conducting appropriate operational research.

The Kenya government is responsible for vaccine procurement both for traditional and non-EPI vaccines. It co-pays for Gavi supported vaccines such as PCV, Rotavirus vaccines, Pentavalent and Yellow Fever. Procurement is done through UNICEF both for traditional and Gavi supported vaccines while the non-EPI vaccines are procured through public procurement procedures through KEMSA. The county governments are also responsible for procurement of non-EPI vaccines and biological through KEMSA.

Table 1.1 demonstrates Kenya immunization schedules

Table 1. 1 : Kenya Immunization Schedule

Vaccine	Ages of administration	Rest of the county	Selected areas of the county
BCG	At birth	X	
OPV	At birth, 6wks, 10wks, 14wks	X	
DPT-HepB-Hib	6wks, 10wks, 14wks	X	
IPV	14 wks	X	
Measles Rubella 1	9 months	X	
Measles-Rubella 2	18 Months	X	
Yellow fever	9 months		ElgeyoMarakwet Baringo West Pokot Turkana
PCV10	6wks, 10wks, 14wks	X	
Rota	6wks, 10wks	X	

*Note: * **HPV for girls age 10 to be introduced in 2019. Other Non-EPI Vaccines offered: Yellow fever fortravellers, Typhoid Vaccine, Hepatitis B, Anti-snake Venom, Anti-rabies**
Source: MOH, 2017

1.1.6 National immunization coverage

Kenya is ranked 119 in implementation of the SDGs' based on 37 health indicators. Although there is indication of progress made in health sector in recent years at a national level, county and sub- county level still experience challenges related to devolution, widening disparity in coverage and inequity which negatively affect implementation of the SDGs and other health goals. Data from MOH indicated that approximately 65% of under-five children were fully immunized against vaccine preventable diseases (VPD), BCG recording the highest at 76% out of an estimated 864,616 births reported, (MOH, 2017).

The country has a population of approximately 42 million out of which 1.5 million are surviving infants targeted for routine immunization services. Despite immunization system in Kenya being fairly instituted, an estimated 450,000 children are yet to be vaccinated. According to the KDHS 2014 finidngs , five regions including Mandera, Wajir,and West Pokot have consistently achieved less than 50% coverage of children under 1 year old. In addition to that, the study notes that immunisation coverage

decreases as birth order increases, with 80 % of children born at first birth compared to 59% at 6th and subsequent birth being fully immunised.

The study also notes that an increase in maternal education increases immunisation coverage ; approximately 75% of children whose mothers have schooled beyond primary or higher education are fully immunised, as compared with 55% of children whose mothers lack education. Only 62 % of children in the least wealth quintile are fully immunised, compared with around 8 in 10 children in the other quintiles.

While over 80% of children in Kenya have received 3 doses of DPT, 27% of sub-counties vaccinate less than 80% of their target population with the utilization of services being lowest amongst the poor, less educated and those living in urban informal settlements (KDHS, 2013). Only 130 Sub-counties out of 286 reports DPT 3 coverage of above 80%.

Figure 1.2 below shows comparison in immunization coverage in Kenya from 1993 to 2014. In the early to late 1990s, the percentage coverage rate dropped from 79% to 65% in childhood vaccination coverage. By 2003, coverage rate had dropped further to 57%. There were mixed gains reported during that period as there was a high rate of under-five mortality and maternal mortality (KDHS, 2014; UNICEF, 2015). This was attributed to inadequate investment in health-related programs alongside with inequalities and disparities across regions. Effects of user fees, co-payments, inadequate hospital, inadequate personnel and high population growth rate especially in the late 1990s' early -2000s' discouraged many mothers to give birth at the facilities (Mwabu et al., 1995; Oyaya & Rifkin, 2003; Chuma et al., 2009).

Figure 1. 2: Trends in childhood vaccination coverage over the past 20 years in Kenya
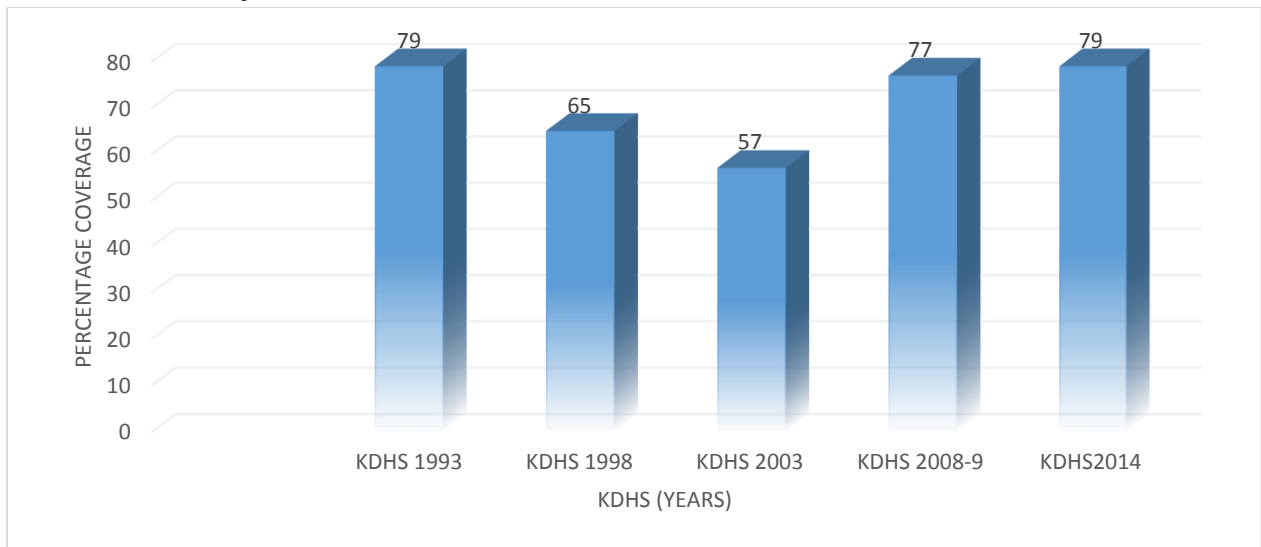
Source: KDHS, 2014

In 2003, the country was in transition across the political and socio-economic sphere, health care programs continued to experience numerous challenges including HIV/AID pandemic. By the end of 2003, with the change of leadership, the then government worked to align with the global goal on MDGs', with the aim of reducing childhood morbidity and mortality. During this period, several policies were ratified; increased programme funding towards health care was at the centre and people were more empowered on their rights and demanding government accountability in service provision.

From 2008 to 2014, although efforts have been made to sustain coverage and minimize inequity of basic vaccines, the health sector has been affected by political instability, health workers industrial strikes, and devolution that has reversed the gain realized in immunization programmes, unmasking under-five children to infections including pneumonia, tuberculosis and polio (MOH, 2018).

1.1.7 Global, Regional and National DTP Coverage

The global coverage of DTP is projected at 85% (WHO, 2017). The Worldwide Vaccine Action Plan, 2015 target set at the national level is 90% with DTP3 and at least 80% coverage at district or county level. However, many countries have failed to achieve

the global targets (Subaiya., et al 2015). It is estimated that 1 in every 5 children under - five years in GAVI supported countries miss out on the 3 doses of DTP (GAVI, 2018). Figure 1.3 demonstrates trends in DTP3 coverage from 1985 to 2017. According to the graph, America (being a developed country) is performing much better in comparison to other countries. It has been able to bypass and sustained the recommended coverage rate of 90% coverage at the national level.

In developing countries, DTP coverage has been improving at a slow pace since 2001. Although it is far below the set target, the steady rise in trends shows some consistency. Although Kenya is performing much better compared to Africa as a continent, there is a lot of inconsistent in trends with downward projections. According to figure 1.3, from 1995 to 1997, there was a steep decrease in the number of immunized children against DTP. The lowest coverage was in 1997 (36%). It later rose sharply to 79% in 2000, which can be attributed to influence from internal community championing reduction in under-five mortality. Due to its unpredictability in utilization of vaccines, it dropped to 63% (2001), there was slight improvement and later on in 2009, there was another steep decline to 73%. Although it rose slightly in 2011 to 85%, since then there has been a downward projection. This is an indication that many children are not being immunized.

Figure 1. 3 :DTP3 trends coverage in Kenya compared with the rest of the world
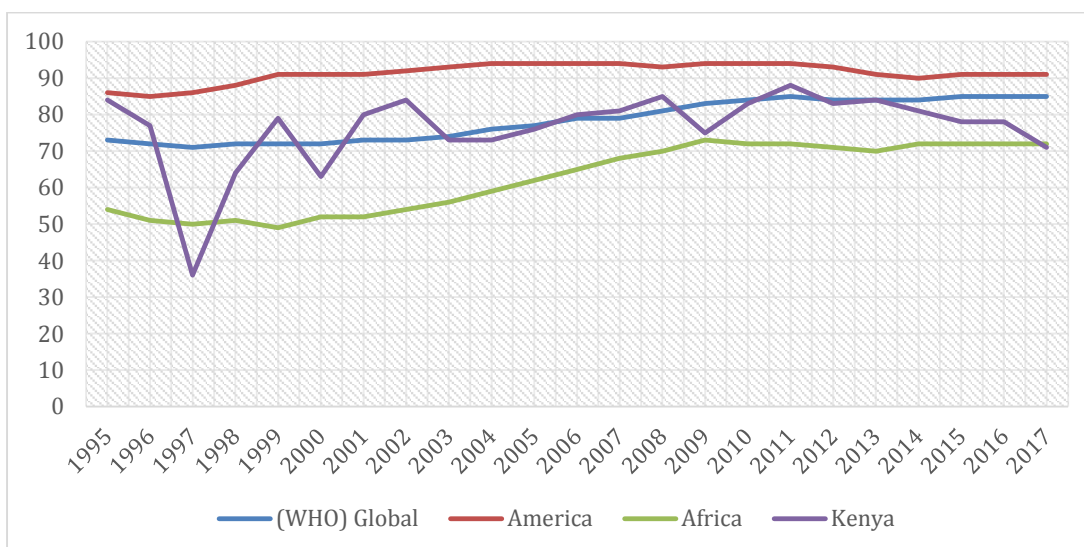
Source: WHO, 2018

Similar trends can be depicted when comparing BCG, DTP and Polio in Kenya. The trends indicate the inconsistency and declining coverage of basic vaccines. The number of unimmunized children is increasing thus increasing their vulnerability.

Figure 1. 4: Trends in Immunization coverage by DTP, Polio antigen in comparison to BCG in Kenya
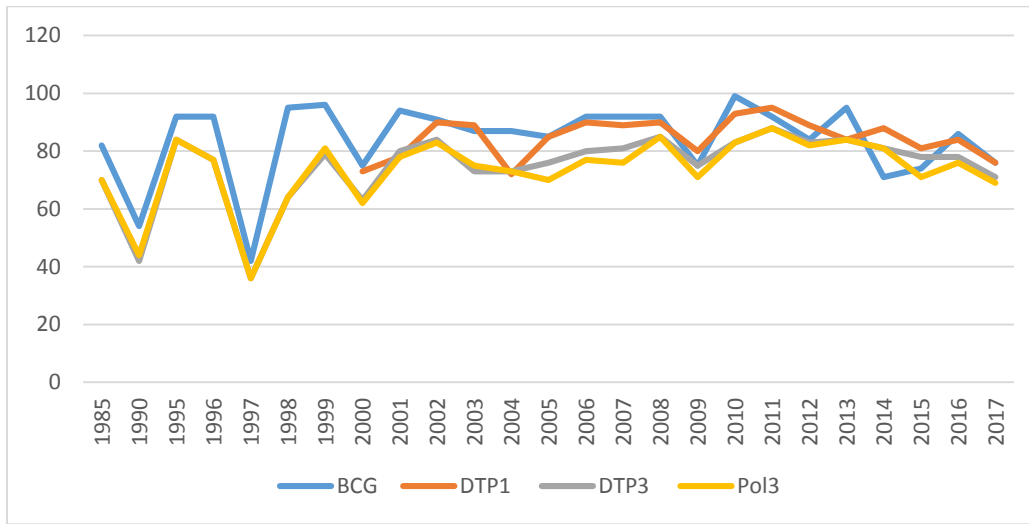
Source: UNICEF, 2018

Figure 1.4 presents immunization trends and coverage in Kenya from 1998 to 2017. The colour code and size of the bubble indicates a shift in the utilization of vaccines. A green shade shows that 90% coverage rate has been achieved. Vaccine drop outs experienced during the first year of life has been scheduled later years. Vaccine amalgamation is ordered from doses administered at birth (see Figure 1.3) to doses given during the second year of life (2YOF).

Figure 1.5 demonstrates added data on the uptake of new vaccines and introduction status; either Pneumococcus or rotavirus vaccine in relation to the traditional vaccines.

Figure 1. 5: Adherence coverage on dosage completion in Kenya
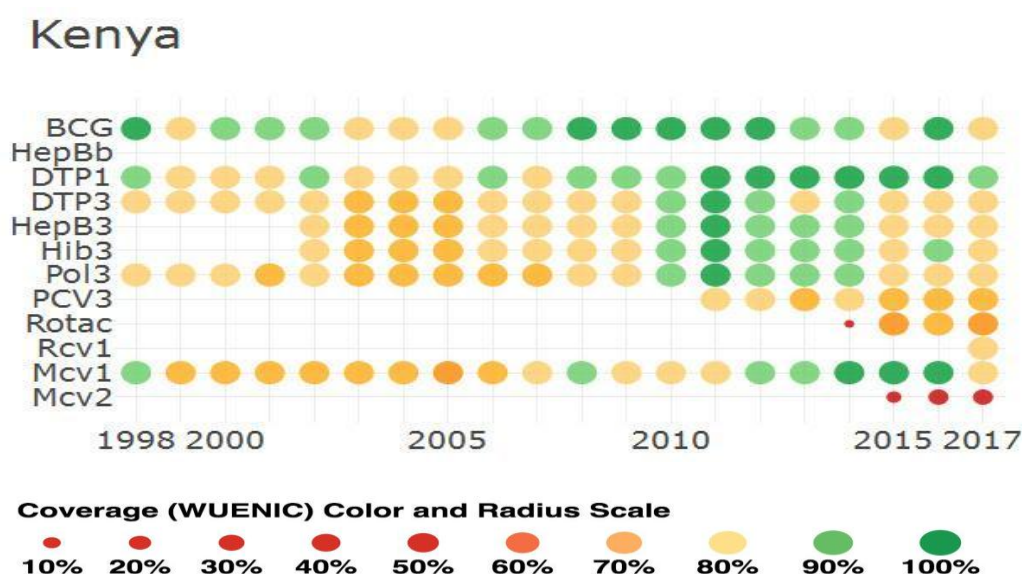
Source: UNICEF, 2018

1.1.8 Immunization Coverage in Bungoma County

Bungoma County is a constituent of Bumula, Kabuchai, Kanduyi, Kimilili, Mt Elgon, Sirisia, Webuye East, Webuye west and Tongaren constituencies. It has been earmarked for '100 days' on rapid routine immunization for a sustained coverage following the presidential policy directive.

In 2014, the immunization coverage rate in the county was at 80.8% for basic vaccines (KDHS, 2014). In 2016, it was one of the counties that reported two thirds (2/3) of its under-five population being unimmunized (MOH, 2017). This is a call for action with further projection indicating a plaetuing and dowards trends in coverage and increasing disparities in health interventions.

The KDHS (2014) reports a high rate of maternal mortality at 25 births per 1000 live births, adolescent birth rate (66.0%) with home deliveries (52.0%) and unemployment rate (50.6%). The MICs report 2014, reported that although majority of children (aged 12-23 months) had been immunized against measles (92%) and BCG (97%) by 12 months and received the 1st DPT (97%), HepB (88%) and Hib (94%) and Polio (96%) subsequent 2nd and 3rd doses of DTP, HepB, Hib and polio (78%) have declined. In addition ,there was a noticeable decrease in the percentage of children aged between 12-23 months who were fully immunized by their first birthday to 56% (KDHS, 2014).

The percentage of fully immunized children age by 12 months was lower for age 24-35 months children by 30%. Individual coverage figures for children aged between 24-35 months are generally lower than to those aged between 12-23 months. The MICs (2014) report also indicated that the rural areas (71%) recorded high immunization coverage compared to the urban areas (59%). This is contrary to what is expected since urban areas have more access to social amenities compared to the rural areas. This discrepancy demonstrates inadequacy in health care systems for improved coverage and equalities in immunization trends. Apart from that coverage has also been affected by socio-economic determinants including gender, wealth, education, access to health services resulting in wide inequalities across numerous coverage indicators (MICs, 2014).

Figure 1.6 demonstrates earmarked counties on polio adherence across selected counties. Although the county is performing relatively well compared to other earmarked counties, it has persistence increased in the number of unimmunized children. There is still reported high number of under-five morbidity and mortality.

Figure 1. 6: Earmarked counties on full vaccination coverage compared to Polio coverge
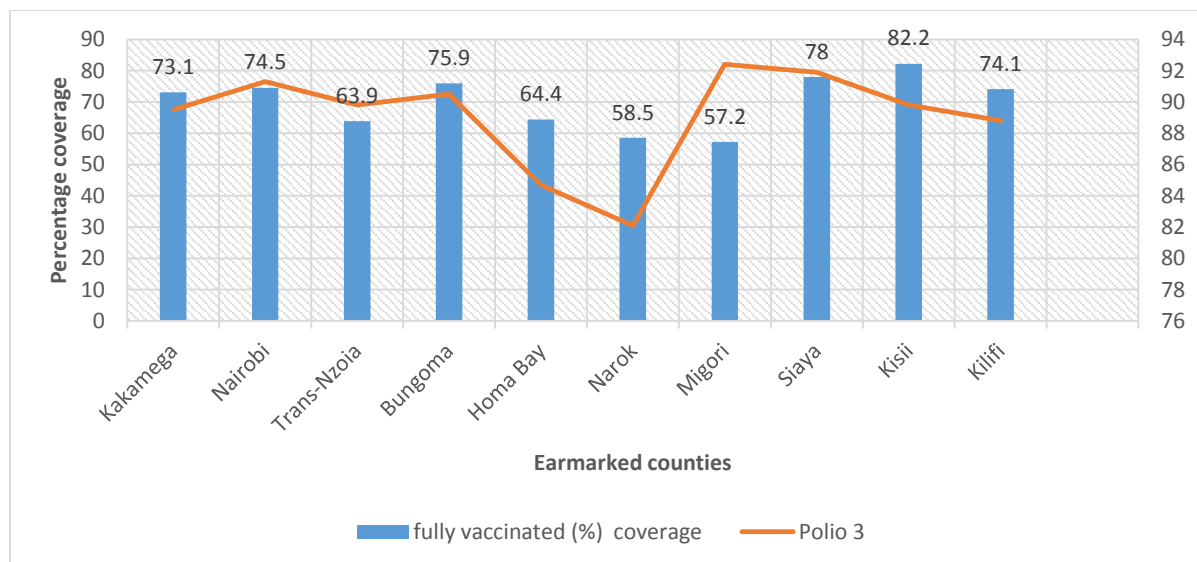
Source: KDHS, 2014

1.2.0. Problem statement.

Bungoma County has recently been earmarked for rapid routine immunization and has been struggling with low coverage and inequity of basic vaccines (KDHS, 2014, MICS, 2014). This study thus intends to study immunization adherence among children under five years of age in Bungoma County. It is perceived that sustained immunization programs are key to global health security (WHO, 2017). Therefore, investing in population in regard to health and wellbeing of children living in poor communities is still an issue of concern (Timothy, 2017; ; Schultz, 2010; UNICEF, 2018).

Although a lot of progress has been made to address VPDs', immunisation adherence at national and county level presents a contrasting trend in coverage for DPT and Polio among neonatal and under-five children for subsequent routine doses (MICS, 2014). This could be hypothesized to be as a result of disparities in socio-economic or low literacy level on adherence to immunisation schedules. This study aims at testing these hypotheses by analyzing some selected variables related to socio-economic determinants as well as estimating maternal knowledge on mother to immunisation adherence.

1.3.0. The main objective of the Study

The main objective is to study the effects of maternal education on immunization adherence among children under- five years in Bungoma County.

1.4.0. Specific objectives of Study

a) To establish the determinants of immunization uptake in Bungoma County.

b) To analyze the effects of maternal socioeconomic status on immunization uptake in Bungoma County.

c) To suggest policy recommendations for the promotion of immunization services uptake in Kenya.

1.5.0. Significance of the Study

This study comes at a time when much emphasis has been placed on UHC and on the countdown of vision 2030 agenda. The trend in immunisation coverage shows inconsistencies and declining trends rates. This is despite extensive efforts made towards achieving global targets on immunisation. There is need therefore to continue investigating the underlying causes on the rising pockets of zero dose and missed cases of immunisation adherence targeting regions which regester low coverage rates and inequities in service delivery.

Secondly, this study helps in bridging the knowledge gap on determinants of immunisation coverage on regional context such as birth order of the child and mother's age at birth on immunisation adherence since the available literature offers minimal insight if any on the role of these factors.

Finally, this study uses multi-indicator cluster survey (2014), the county-based survey that narrows down to county-specific challenges on immunization adherence in Bungoma, which differs remarkably from other regions in rates and trends of immunization coverage. Immunization programmes require continued nurturing and attention in order to provide a wider platform for service delivery for primary health care and to take advantage of and harness new technologies to reach unimmunized children.

2. 0 CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

In this section, the literature review of the determinants of immunization adherence among the children under five years is captured with an overview of the literature in which the research gaps are identified.

2.2 Theoretical Literature Review

Studies were done by Alderman, 2006 and Miller & Wheeler, 2014 to document the need to invest in early childhood development in nutrition and health. The investment in early childhood development leads to several positive effects on long term economic development and human capital (Schultz, 2003, Anderson & Hague, 2007). Numerous theories have been developed to demonstrate the need to invest in health. The human capital theory and consumer expected theory have been used widely in this study to demonstrate the need to invest in health.

2.2.1 Human Capital Theory

The demand for commodity explained by the Grossman model as it is good health. Therefore, health is a resilient capital stock which leads to the production of healthy time as a result. Grossman states that a person gets a primary needs of health that loses its value with age.

However, health is affected by other variables apart from health care cost. Increase in cost of health care accessibility results from an increase in age, gives rise in the rate of depreciation on the stock. Education can be reduced if more educated people are more producers for health.

At an initial stage, an increase in an individual's human capital may increase the productivity of an individual in the market where the production of money earnings in the non-market sector is at the utility function. Investment in education and on-job training results from incentives from unrealized output to a certain level. The cost of this investment is a direct investment in opportunity cost and market goods. The model has been further advanced by Ben, (1967) to establish the maximum amount of investment in human capital. This model shows that difference in the maximum amount over the life cycle of an individual and in the same age – group.

Moreover, health capital changes according to the other types of human capital since an individual's stock of knowledge affect productivity at non-market and market levels. While stock of health can affect overall aggregate duration in production of commodities and money earnings. According to Muurinen, (1982) and Grossman, (1972) , key variables in health production considered by this model are health status, income, education and age through demand for human capital.

In addition to that, the model states that, as a consumer, an individual demand '*good health*' rather than health services, however, the services and good health bought from the market enters consumer utility function according to traditional demand theory. Economists emphasis the importance of the demand for medical care but ignoring the demand for health.

Poor health rises vulnerability. Ill health may lead to depreciation of a person's initial stock of health, even though, individual can maintain his or her health and enjoy utility through investment in the health initiatives. Grossman (1972), suggests that people can produce using different commodities and the inputs of time.

Socioeconomic status influences the health status of a person. Utilization of health services consider some factors; for example health status, health belief variable, age and access to health care. The satisfaction of optimum utility occurs when mothers get satisfaction by consuming health care like doctor's consultation, family planning and antenatal visits. These health services, directly and indirectly, influence the health of a child that comes from the Health Belief Model and the Grossman demand for health model. Therefore, its services is a derived demand. The depreciation of an individual's stock of health occurs at an increasing rate through investment can help such a person to maintain his or her health. Depreciation of this stock to a certain level may lead to death.

The household production function produced the Gross investment in health capital such as recreation, medical care, exercise and diet. Environmental factors may also hinder the production function of health care. According to Nocera & Zweifel (1998), Grossman proposes that increase in healthy time, income and education may lead to increase in health level demand while ageing, diseases and poverty may lead to decrease in the stock of health.

Competing resources limits health care resources. Mothers face various demographic and socioeconomic factors that limit their utilization compared to health care utilization. According to Li (1996), Inadequate finances motivates mothers to try to optimize their utility function in human capital model with health inputs which can be described as socio-demographic determinants affecting people's health preferences especially in the utilization of preventive health services. The determinants relate to child and mother as a factor of the demand for health model through the health inputs or immunization integrated are expressed as;

$$Health\ stock\ at\ a\ time(t) = Health\ Stock - depreciation + Investment\ in\ Health$$

The model concludes that individuals demand health for two main reasons that are consumption commodity and investment commodity.

2.2.2 Demand for health care production model

Inception to early development stages forms the demand for health foundation that mother influence infants' growth (Ajakaiye et al., 2007;Srinivasan, 1988; Rosenzweig & Schultz, 1983; Reichman et al., 2009).

Empirical pieces of evidence have established that distribution of resources and family size have a significant impact on the per-capita income levels of family and the overall economic growth; this is because the phenomenon directly affects the resource allocation of human capital in children (Ajakaiye et al., 2007; Schultz, 1999). For example, large families allocate few resources to happiness and education of their children as compared to a family with few children. Apart from that, mother's characteristics when expecting and after delivery; prenatal care during delivery and postnatal care, have a weighty bearing on the children development (Reichmann et al., 2009).

2.2.3 Consumer's expected Utility theory

According to Bell (1985), the decision making of an individual is aligned to the person's preferences, and in the middle of unpredictability, individuals tend to maximize their utility. Consumer's expected utility theory plays a significant role in explaining consumer decision making when it comes to purchasing insurance products.

Bell asserts that a consumer is always surrounded by uncertainty. However, despite these uncertainties, a consumer makes decisions on one's health, environment, relationship with others and the economy. Additionally, individuals will make rational choices due to uncertainty (Viscusi & Evans, 1990). Bell further postulates that utility can be increased in wealth and is in reverse proportionate to the number of goods in possession. Logarithmic utility function has been presented alongside the concept of a declining marginal utility function. Therefore, decision-making must be focused on expected utility.

Understanding an individual's mentality towards hazard is significant as it will assume a vital role in the decision-making process of the individual. Thus, the decision-making process is based on chance. A risk-averse person will not make a decision based on chance while a risk-neutral individual will be unresponsive to make the choice and a risk-loving person will be ready to take up the risk based on chance.

2.3 Concept of Expected Utility and Immunization

Immunization is a public good. The government acting as the insurer takes calculated risks as a way of investing in health for her people as a means to build and sustain economy Briggs (2014). On the other hand, the consumer (mother) aims at maximizing her expected utility. Immunizing a child provides a greater utility than not immunizing. Utility increases with being insured (immunized). Being insured entails that the insurance company (government) will incur all her losses. In such a case, a mother will there ensure that her child has been immunized. The government will incur the cost of ensuring she can access vaccines that her child needs.

In setting the price for the product, the insurer has to ensure there is willingness buyer while at the same time they are able to make stipend for profit. Therefore, to increase the demand for vaccines, the insurer will be required to minimize the price of the insurance. Immunization is a public good, providing at a fee will discourage the mother to take the service and there will be a huge public health dilemma.

The consumer utility theory drives decision making under uncertainty. The government, being policy and implementing body has the responsibility of providing health care to its people. The normal utility theory plays a significant role in guiding the insurer on the most proficient method to value the protection item.

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In order to strike a balance between providing service to its people and expected cost incurred to delivery vaccines, the government collects revenue, sets aside earmarked funds for immunization programs, works with donor community as a way of subsidizing cost in provision and delivery for a vaccine for free. This way under five is able to access immunization services for free in government facilities. By doing this, the government is able to pool risk across the population through herd and community immunity.

2.4 Empirical Literature Review.

Several studies have been documented as evidence between stronger public health systems and child subsistence. However, in low-income countries, millions of children under five years fail to live up to first of life (Etana, & Deressa, 2012; Abdulraheem et al., 2011; Waroux et al.,2013). Orinsganje et al., (2016) notes that despite vast investment made, there has been a continuous report of high rates of morbidity and mortality cases among the under-five populace.

2.4.1 Determinants of Immunization

Maternal education plays a significant role in improved attention of major public health interferences across a range of care (Miyahara et al., 2016). Improvement of mother's education beyond primary level enables women to be empowered and make health-decisions for themselves and their family members, participate in income-generating activities and reduce gender inequality.

Maternal health education has an impact on health care utilization (Etana & Deressa., 2012; Jennings et al., 2014). Education enables mother to evaluate, integrate and assimilate health messages. Similarly, in their study, Birmeta et al., (2013) deduced importance of immunisation adherence by designing simple health education messages that they can easily relate to (Signoret, 2003; Weil, 2017) states that an educated society reduces inequalities and promotes the growth of a country.

Studies have also shown the impacts of mass media on public health intervention such as immunisation, breastfeeding (Mannion, et al., 2013; Mashreky et al., 2015). Their findings suggest that mass media has a positive effect on knowledge, attitude and behaviour of mothers in utilisating public health interventions.

Miyahara et al., (2016), documents the need to integrate child health programs with other public health inter entions for instance immunisation and maternal services. In their study, they note that integration of birth doses vaccines with other health interventions will be maximizing public health impact at minimum cost e.g Second year of life platform enables administration of supplementary health intervention such as deworming, nutrition, growth monitoring and vitamin A supplementation.

Distance to health facility by communities have been associated with low – uptake of health services, this is in line with studies done by (Figueiredo et al., 2016; Adedokun et al., 2017). Gram et al., 2014 states that in female-headed household, under-five children are less likely to be immunized more so if they come from disadvanatages families and living in rural or informal settlement. (Keats et al., 2017). According to Favina et al., 2012, long waiting hours, stock out of vaccines contributes to missed opportunities, mothers fail to return their children for routine immunisation.

Kabubo et al. (2012) report that children from rural and marginalized communities are less likely to adhere to the immunisation schedule compared to the urban areas. This is associated with challenges relating to access to resources and high vulnerability conditions due to hardship conditions. These studies tally with Osita et al., (2015); Ettarh and Kimani (2012), they observe that investing in primary health with much empahazies in rural areas is one way of improving access to immunisation services which is key for child survival. Children born or who live with non-educated parents are unlikely to be immunized (Wiysonge et al., 2012). This statement agrees with similar work done by Gram et al., (2014) in Ghana. They established that children living in rural areas and from less educated families were severely delayed in receiving scheduled antigens.

In contrast to previous studies on improved coverage in urban areas Mendy, et al., (2013); Vonasek et al., (2016); Oberoi et al., (2017), and Miyahara et al., (2016) found out that in rural areas of the Gambia, there is a high coverage compared to urban areas. According to their research, this difference could better the implementation of primary health care in rural communities under the community health nurses (Jasseh et al., 2015). Village health workers play a significant role in mobilizing communities on health outreach programs and follow up with expectant mothers to ensure that they adhere to routine immunisation.

Keats et al., (2017) in their findings notes that disaggregation of intervention by wealth quintile indicates significant disparities among the poor and the rich. Though scope per quintile tended to expand over time, children from low-income households missed important vaccines due to challenges related to access to medical personnel, vaccines, distance, cost and lack of awareness or information on immunisation.

In Kenya, numerous studies have reported regional imbalances in inclusion of full immunisation, skilled birth assistance and family planning (UNICEF, 2015; Keats al., 2017). Counties most affected by these inequalities in health interventions include Northern, Eastern, Northeastern Rift Valley with low coverage compared to other counties such as Nyeri, Muranga who have better coverage (KDHS, 2014; Keats al., 2017). Similar studies conducted in Ghana indicates negative effects of disaggregation according to wealth quintiles on immunisation amoung under-five chidren especially among the lowest quintiles with the low level of education, the parents tend not to immunize their children (Gram et al., 2014).

Studies have documented distinct disparities in coverage and equity of RMNCH interventions by rural or urban classification, education level, wealth group (WHO, 2014, KDHS, 2008-9). Studies done by Heymann & Aylward, 2015; UNICEF, 2005, have documented efforts done through universal childhood immunization initiative as a way of improving coverage and equity on immunisation among the under- five population.. Health system factors such as human resource for health, community-based interventions, acces to vaccines   contributes extensively in improving immunisation coverage (Makaka et al., 2012; Manzi et al., 2018; Tunçalp et al., 2018).

Several studies have stated that child survival levels of different countries are related to the development of the economy (Ozawa et al., 2016; Fernandez et al., 2011). Therefore, a unit increase in welfare for children increases public expenditure with a realistic effect on economic growth especially in developing economies (Anderson & Hague, 2007). Signoret (2003) states also that this can be perceived as a path of economic development and welfare.

In Rwanda, studies have documented how health systems reforms were done in the country to increase maternal health utilization services (Manzi et al., 2018; Bucagu et al., 2012). The utilisation of health care is positively associated with additional health-

seeking behaviour including family planning services and immunisation services (George, et al., (2015); Manzi et al., (2018); Njeru et al., (2019).

Through the community health system model, the Kenyan government has been able to ensure that the every child has access to basic health care interventions especially in rural and marginalized communities .Through the integrated child case management (iCCM) program, more services have been delivered and a perceived decrease in neonatal and maternal mortality (Njeru et al., 2019). Similar studies have been down in Rwanda on community-based health financing as a way of promoting universal health coverage (Manzi et al., 2018).

Johri et al., (2015) in their study compare facility-based health education with community-based health education, while   George, et al., (2015) compared community-based health education with no intervention, while Owais et al., (2011) compared community-based health education with health promotion given verbally. Their findings indicated that community-based health education increases immunisation coverage, however, they also noted facility-based health education had minimal to no effect on immunisation adherence in DTP uptake. These studies agree with studies done Basinga et al., (2011) in Rwanda who noted that consistent outreach programs increase coverage for full immunisation among the under-five population.

2.4.2 Methodological Considerations and Data Choices

Wiysonge et al., (2016) used a meta-analysis to determine immunisation adherence in developing countries. A similar concept was adopted by Forshaw et al., (2017) on cross-sectional studies on immunisation adherence across Africa and Asia.

A logistic regression model has been applied by Wiysonge et al. (2012) on both contextual and individual factors associated with low immunisation coverage across 24 countries in sub-saharan Africa. A similar model has been adopted by Schoeps et al., (2013); while a different model of log-binomial regression model on effects of public health interventions on child survival and development in Kenya has been adopted also by Gibson et al.,(2015). In addition, Keats et al., (2017) utilized linear regression model to examine priorities and progress for child health, newborn, maternal and reproductive in Kenya.

A poison regression analysis has been used by Agusta (2009) to establish an association between exposure and infant mortality variables in Tanzania whereas the binary outcome was infant mortality.

A descriptive cross-sectional study also was conducted by Njeru et al., (2019) on the utilization of immunization services among children under five years in Kenya (Kirinyaga County). Manzi et al., (2018) used Chi-squared test in their studies to analyze different ways of improving coverage beyond health facilities in Rwanda.

Malderen et al., (2013) conducted a decomposition analysis on socio-economic disparities in measles immunization and skilled birth attendance in Kenya. The findings showed that some determinants are negatively associated with wealth-related inequality.

A systematic literature review on DTP dosage completion was conducted by Favin et al., (2012) and Calhoun et al., (2014). Over126 documents from the global grey literature were reviewed. Similar reviews have been done by (Waroux et al., 2013;) on factors associated with slow vaccine uptake during the first week of life and proximity to health services and child survival rates in selected countries across developing nation (Okwaraji et al., 2012). In Rwanda, Bucagu et al., (2012) established a systematic literature review on the impact of health systems strengthening on newborn health and maternal services.

2.4.3 Proximate, Behavioral, and Demographic Factors.

In Tanzania, a study was done by Agusta, (2009) on the effect of birth order on under-five children mortality. The study notes that the infant mortality rate is higher at first birth. This study concurs with research done by Malderen et al., (2013) who notes that birth order and measles adherence were statistically significant across communities in Kenya.

Malderen et al., (2013) examined the relationship between measles immunization coverage skill birth attendant in Kenya. The study found out that skill birth attendant utilisation increased with parents' education and household wealth quintile.

Studies have also demonstrated the effects of ethnic affiliation on the utilisation of health services such as Gyimah (2002); Aseweh et al. (2011) and Agu and Nnaji (2015). In their studies, reports have shown that communities such as Kikuyu in Kenya

have increased utilization of traditional birth attendants and easier access to health services for family planning. This intervention provides an opportunity to reach out to more women of reproductive age category, easier access to interventions that meet their needs (Manzi et al., 2018). The study was done by Njeru et al., (2019) and found that misconceptions and myths affected the utilization of immunization services.

2.5 Overview of Literature review

This study reviewed both theoretical and empirical studies with respect to immunisation adherence among the under-five population. Although a lot of progress has been made towards achieving the county (80%) and national level (90%), there are immunisation adherence gaps especially among poor and vulnerable, marginalized areas. From the reviews, challenges in immunisation are categorized into socio-demographic, health systems and individual characteristics. Individual factors such as (occupation, marital status, birth order of the child, births, mother's age at birth etc.) have been associated with low completion coverage (Alaba & McIntyre, 2012; Keats et al., 2017; Etsano et al., 2015; Calhoun et al., 2014). Various analytical techniques such as multivariate regressions, linear regression analysis have been utilized by different studies in estimation.

3.0 CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter outlines the methodological approach utilized to meet the study objectives. In particular, it presents the theoretical framework informing the study, estimation models and estimating techniques, study variables, diagnostic tests, study area and data source and type.

3.2 Theoretical framework

The key concern of economist in health is due to clear health as a component of human capital (; Mwabu, 2009).

With the theoretical framework, this study employed the human capital model which has been simplified and established by Mwabu (2009), Rosenzweig (1986), Rosenzweig and Schultz (1983) and Grossman (1972).

In order to improve the efficiency of the market sector in the economy, an individual human capital and stock of knowledge must be assumed by this above model, therefore, one can generate revenue and creates products that enter one's utility function.

According to Rosenzweig & Schultz (1983), a reduced form health demand equation can be employed to study immunisation adherence. The equations are health production function and the health input demand equation.

Polio and DTP antigens are seen as key health inputs for health production function. An individual makes a decision based on utility maximization from use of services and goods.

Polio and DTP (Immunization) utility maximization function can be derived as;

$$U = u(X, Y, H) \quad \text{..} \quad (1)$$

Where;

X represents goods consumed for utility purposes with no direct impact on health such as maternal education and gender of child Y is goods consumed to impact on health such as immunization, nutritional food, breastfeeding.

Schultz (1984) states that immunization adherence I is determined by socioeconomic factors (y) such as household wealth index, mother's age at first birth, marital status

and child's health input goods/services (w) such as birth order of child, health systems characteristics (such as antenal services) (h) and mother's education level (k). Schultz (1984), states that a child health production function is therefore given as a linear function of;

$$I = f(y, k, w, h) \quad \text{...} \quad (2)$$

A mother chooses to immunize her child I with the aim of increasing immunity against vaccine-preventable diseases. The inputs choices are based on (h) health systems characteristics, child inputs (w), household socio-economics (y) characteristics of the household, prevailing market prices and household's physical environment constraints (P).

A mother, therefore, maximizes utility U given child health production function (I) subject to mother's financial constraints was given as;-

$$M = P_x + P_y + P_I \quad \text{...} \quad (3)$$

Where; M is the household income level, P_x is the price of consumption good, $(x) P_y$ is the price of health-associated goods(y), P_I price of a child input (I). Prices and household income are set by the market and thus assumed to be exogenous to the household and thus by extension to child health.

The reduced form of immunization adherence demand equation is given as;-

$$D_Y = D(P_y, P_I, k, w, h) \quad \text{..} \quad 4b$$

$$D_I = D(P_y, P_I, k, w, h) \quad \text{...} \quad 4c$$

Substituting demand functions for y and I (4b and 4c) into health production function (2) the equation becomes;-

$$H = f(D_y(P_y, P_I, k, M, w, h), D_I(P_y, P_I, k, \mu)k, w, h) = F(P_y, P_I, M, k, w, h) \quad \text{..............} \quad (5)$$

From equation 5, immunisation adherence is determined by household socio-economic (y), child's health inputs (w), access to antenal services (h), mothers' education level (k) and market inputs (M) and relative prices $P_y \; and \; P_I$.

Kosted et al., (2003) notes that assuming prices are identical for all households and thus minimizing it form input demand equation, it is given as:-

$$I = F(y, M, k, w, h) \quad \text{..} \quad (6)$$

From equation 6, Immunisation adherence can, therefore, be explained by household socio-economic (y), child's health inputs (w), access to antennal services (h), mothers' education level (k) and market inputs (M) Mother's education is positively related to immunization adherence; because the immunization of children depends on high level of educated mothers compared to those are uneducated ones.

The study follows Kovsted et al., (2003) where it is assumed that similar commodity price for all public health goods and estimate child health as a product of direct socio-economic products (y), child health input (w), access to antennal services (h) and mother's education level (k)

3.3 Empirical Model Specification

The study utilized data on Polio or DTP doses, from MICS 2014. A probit model is estimated to study the effect of maternal education on immunisation adherence in Bungoma County

Assuming that a mother's decision to immunize or not to immunize child *ith*, depends on *unobservable* utility index *li (latent variable)*, which can be determined by one or more independent variable (e.g. Mother's education (me_i)), in a manner that the larger the value of the index l_i, the greater the probability of immunizing a child can be expressed as '

$$\gamma = \beta_1 + \beta_2 x_i \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{ (7)}$$

Where x_i is the ith child to be immunized

Let $Y = 1$ if a child receives 3 rounds DTP or 4 rounds Polio and Y= 0 if a child fails to receive complete dosage.

The equation can be further be written as

$$Y^* = Xi\beta + \text{Ɛ} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{ (8)}$$

Where Y^* represents the dependent variable immunization or not, X_i represents determinants of immunization, β represents the coefficients to be determined and Ɛ is the error term. The maximum likelihood method (MLE) is applied in the estimation of the probit model is given as;-

$$Yi = \begin{cases} 1 \text{ if } y > 1, \\ 0 \text{ otherwise,} \end{cases} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{ (9)}$$

According to the normality assumption, the probability l_i^* is $\leq$ to l_i can be computed from standardized normality as;

$$P_i = p\left(\frac{Y}{X}\right) = (l_i^* \leq l_i) = P(Z_i \leq B_1 + \beta_2 x_i) = F(\beta_1 + \beta_2 x_i) \dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(10)}$$

Where; - $P\left(\frac{1}{Y}\right)$ means the probability immunization that arises from a given the value (s) of X or independent variable (s) and where Z_i represents the standard normal variables i.e. $Z \sim N(0, \sigma^2)$. F is the standard normal written as:

$$F(l_i) = \frac{1}{\sqrt{2}}\pi \int_{-\infty}^{l_i} e^{-z^{2/2}dz} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(11)}$$

Which is expressed as;-

$$F(l_i) = \frac{1}{\sqrt{2}}\pi \int_{-\infty}^{\beta_1 + \beta_2 X_i} e^{-z^{2/2}dz} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(12)}$$

From equation , p represents the probability that a child is immunized, the probability of immunization adherence for polio or DTP, is measured by the area of standard normal curve from ∞ to $\beta_1 + \beta_2 X_i$

To obtain information on l_i, the utility index, as well as on β_1 and β_2 and inverse of equation 4 obtains;-

$$l_i = f^{-1}(l_i) = f^{-1}(p_i) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(13)}$$

$$= \beta_1 + \beta_2 x_i \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(14)}$$

Where f^{-1} is the inverse of normal cumulative distribution function.

3.3.1 Model Specification

Immunisation adherence is estimated as a dummy variable; taking value 1 if a child has received vaccines dosage completion and 0 otherwise. DTP and Polio have been used in this research respectively. DTP is administered 3 doses while polio administers 4 doses. Taking value 1 if a child completes DTP or polio and 0 otherwise. The binary response to the respective antigen will be specified as:-

$$P = \{1\ if\ \ p\ > 0, 0\ other\ wise\ \} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots.. \text{(15)}$$

$$DTP = \{1\ if\ \ DTP\ > 0, 0\ other\ wise\ \} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(16)}$$

In this study, immunization function is regressed against maternal education, mother's age at first birth, birth order of the child, household wealth index and access to antenatal care. While B's, are slope coefficient of parameters and ε represents the stochastic error term.

By controlling the diagnostic issues, the following equation has been expressed as;

$$Y_i = \beta_\circ + \beta_1 ME + \beta_2 BoC + \beta_3 HHW + \beta_4 Ac + \beta_5 MA + \varepsilon \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (17)$$

Where $ME = Mother's\ education$

$BoC = Birth\ order\ of\ the\ child$

$HHW = Household\ wealth\ Index$

$Ac = Access\ to\ ante-natal\ care$

$MA = Mother's\ age\ at\ first\ birth$

3.4 Definition and Measurement of variables

3.4.1 Dependent variable

This study has used Polio and DTP as the dependent variable of interest. They are recognized widely by WHO as basic vaccines for child survival. Polio and DTP have been recorded as a dummy variables form with an immunized child taking value 1 and 0 otherwise. DTP is administered 3 times while polio is given 4 times, the endogenous variable is estimated by the accomplishment of dosage for respective antigen.

3.4.2 Independent variables

In this study, estimates considered as explanatory variables are mother's characteristics such as maternal education , mother's age at first birth and birth order of the child, household hold characteristics such as household wealth index and health systems characteristics such as access to antenatal care. Numerous literature reviews demonstrated various determinats that impact coverage and equity which affect immunization adherence.

Table 3. 1: Variable description, measurement and expectations

Variable Name	Definition	Measurements	Expected sign
Dependent Variables			
DTP 3 vaccination adherence (DTP)	Immunization status of the child between 0-5 years. A child is fully vaccinated against DTP when he/she receives 3 doses of DTP as recommended by WHO.	This is as a result of merging DTP variables for children between 0 -5 years. coded as (1) if a child receives a minimum of 3 doses for DTP vaccines and zero (0) if otherwise	
Polio Vaccination adherence(PW)	Vaccination status of the child between 0 – 5 years. A child is fully vaccinated against polio she/he receives 4 doses of the Polio antigens as recommended by WHO	This is as a result of merging variables of Polio for children between 0 - 5 years. coded as (1) if a child receives a minimum of 4 doses for polio and zero (0) if otherwise	
Independent Variables			
Child Characteristics			
Birth Order of the Child(BOC)	The order or number of a child among his/her siblings	1 (1) 2-3 (2) 4-6 (3) 7+(4)	Positive (Schoeps et al., 2013)
Mother's Characteristics			
Maternal education (MA)	Mother's highest level of education attained.	None (1) Primary (2) Secondary+ (3)	Positive (B. & W., 2012; Forshaw et al., 2017; Njeru et al., 2019; Schoeps et al., 2013)
Mother's age at first birth	Mother's age at first birth	<20 Years (1) 20-34 Years (2) 35+ (3)	Negative Njeru et al., 2019) Positive (Gibson et al., 2015)
Household characteristics			
Household Wealth Index (HHW)	The economic status of the family	Wealth status. Poorest (1), Second (2) Middle (3), Fourth (4), Richest (5)	Positive (Gram et al., 2014; Schoeps et al., 2013; Wiysonge et al., 2012) negative
Access to health care			
Access to antenatal services	Visited health centres	Yes (1) No (2)	Positive (B. & W., 2012; Gurmu & Etana, 2016; Wiysonge et al., 2012)

Source: Author

3.5 Description of Study Area

The scope of the study is in Bungoma County. The county is approximately 3,032.3 km² (0.52% the total national area). It is a home to approximately 1,375,063 population (male 48.8 % and female 51.2 %), 56% of the population are 18 years and below (KPHC[4], 2009). The county projected population as of 2014 is at 1,605,603 and is expected to grow to 1,874,795 in 2019. The major sub-tribes are the Bukusu, Tachoni, Saboat and Tura. Agriculture is the major livelihood activity drives the economy of the county.

The major killer diseases in the county include malaria, anaemia, pneumonia and diarrhoea (KDHIS, 2017). The KDHS 2014, puts stunted growth among children under 5 years at 24% against the national 26%. The county has recorded the highest rates of maternal mortality in Kenya, estimated to be 382 deaths per 100,000 live births (KDHS, 2014).

3.6 Data types and sources

The study utilized county cross-sectional data (MICS 2013-2014) for Bungoma County. A set of three questionnaires was administered during data collection exercise. The questionnaire was grouped into the household questionnaire and individual women questionnaire (15 – 49 years) to the respective household.

The MICS survey provides statistically sound comparison data on state of women and children at the county level, for rural and urban areas. Therefore, the information generated is critical for evidence- based interventions, policies and programmes and for monitoring progress toward national goals and global commitments

Data was collected from 1,246 households with approximately 95% response rate. The household was made up of 5,983 household members, comprising 2,797 males and 3,186 females. About 48% of the sampled households population is below 15 years, 48% are between age 15-64 years and 4% per cent are age 65 years and above. According to the MICS report 2016 report, ony 64% of the under- five children were fully immunized. Coverage rate for a fully vaccinated child was higher in the rural areas at 71% compared to the urban areas at 59%.

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[4] KPHC- Kenya Population and Housing Census

During data management exercise, the county data was categorized into the cluster and household number using unique identifiers to make it possible for data users to be able to perform an analysis. Before any further analysis, new variables were regenerated to make analysis easier in line with the study objectives. For example, mother's age at birth was categorized to <20, 20- 34 and 35+, birth order of the child was categorized to 1, 2 -3, 4- 6, 7+, mother's education level was categorized into none, primary and secondary+.

Data was presented through descriptive statistics analysis. This is presented through means, proportions, frequencies and standard deviations and regressions were then done using statistical software STATA version 13.

4.0 CHAPTER FOUR: DATA ANALYSIS

4.1 Introduction

This chapter presents the study findings and discussion of empirical results on the effects of maternal education on immunisation adherence among children under-five years in Bungoma County.

4.2 Sampled description

This section presents descriptive characteristics of immunisation adherence among under-five children in Bungoma County sampled during the 2014 MICS as shown in Table 4.1. The variables under study include; immunization adherence (DTP and Polio) among under-five children, household wealth index, mother's education, access to antenatal services, mother's age at first birth and birth order of the child.

Table 4. 1: Summary statistics of variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Polio Vaccination adherence	2,222	0.369	0.483	0.00	1.00
DTP 3 Vaccination adherence	2,152	0.838	0.368	0.00	1.00
Mother's Education					
Primary	2,387	0.642	0.480	0.00	1.00
Secondary	2,387	0.327	0.469	0.00	1.00
Birth Order of the child					
2 to 3	3,417	0.372	0.483	0.00	1.00
4 to 6	3,417	0.271	0.445	0.00	1.00
7+	3,417	0.094	0.291	0.00	1.00
Mother's age at first birth					
20-34	3,417	0.710	0.454	0.00	1.00
35+	3,417	0.080	0.271	0.00	1.00
Access to Antenatal Services	3,475	0.264	0.441	0.00	1.00
Household Wealth Index					
Second	3,417	0.187	0.390	0.00	1.00
Middle	3,417	0.201	0.401	0.00	1.00
Fourth	3,417	0.208	0.406	0.00	1.00
Richest	3,417	0.183	0.387	0.00	1.00

Source: Own computation based on MICS, (2014)

Table 4.1 shows the minimum, maximum and average as well as the standard deviation of the study variables. As indicated in the above table, the study considered immunisation adherence (DTP or Polio) as the dependent variable while maternal education, mother's age at first birth, household wealth index, access to antenatal services and birth order of the child as independent variables. The study respondents were based on the mother's information and information from immunization cards.

From the study findings, approximately 36.9% of the respondents reported that their children – under five years completed polio immunisation adherence and 83.8% of the children under-five years received full immunisation against DTP.

Mothers who attained at least primary education were approximately 64.2% with a variation of 48% compared to mothers who attained at least secondary education which was at approximately 32.7% with a variation of 46.9%. Mothers with no form of education were 3.1% with a variation of 5.1%.

On average children who were of birth order 2 to 3 was 37.2% while those of birth order 4 to 6 was 27.1% and those of birth order 7+ was 9.4%. Additionally, majority of the women's age at first birth was of age bracket 20 – 34 at 71% with those below 20 years recording an average of 21% while those above 35 years recording an average of 8%. On the other hand, about 26.4% of women had access to antenatal services prior to the study, this could signify that uptake of medical services among the women in the community is very low. This might have contributed to the low immunisation adherence, especially on polio vaccines. On average, all the women sampled ranked at 22.1% being poorest, 18.7% being the second poorer, middle quartile was 20.1%, the fourth quartile was 20.8% while the richest was 18.3% on the household wealth index.

Correlation Analysis

Table 4. 2: Pairwise Correlation Matrix

Variable	Polio Vaccination adherence	DTP 3 Vaccination adherence	Mother's Education	Birth Order	Mother's age	Access to Antenatal Services	Household Wealth Index
Polio Vaccination adherence	1						
DTP 3 Vaccination adherence	0.3792	1					
Mother's Education	0.1321	0.0997	1				
Birth Order	-0.0757	-0.2359	-0.1965	1			
Mother's age	0.0963	-0.0196	0.1073	0.5303	1		
Access to Antenatal Services	-0.0050	0.0177	-0.0485	-0.0090	0.0158	1	
Household Wealth Index	0.2198	0.2228	0.3886	-0.1487	0.0931	0.0135	1

Source: Own computation based on MICS, (2014)

4.3 Diagnostic tests

4.3.1 Multicollinearity Test

A pairwise correlation was estimated to establish the relationship between immunisation adherence (DTP or Polio) and the other independent variables of the study. The Positive and negative signs in the analysis indicatite the direction of the association between variables. From table 4.2, immunisation adherence was found to be positively correlated with mother's education, mother's age at first birth and household wealth index while the other variables birth order of the child and access to antenatal services had a negative correlation with immunisation adherence. Generally, most of the correlations were less than the absolute value of 0.5 implying absence of Multicollinearity.

4.3.2 Heteroscedasticity test

The study utilized heteroscedasticity probit model test to ascertain variation/constancy of the variance. Also, robust standard errors was utilized to address the possible presence of heteroscedasticity.

Table 4. 3: Bivariate Probit regression Analysis

Variable	Coeff.	Robust Std.Err.	z	P>|z|	[95% Conf.	Interval]	Variable	Coeff.	Robust Std.Err.	z	P>|z|	[95% Conf.	Interval]
Polio Vaccination Adherence							**DTP 3 Vaccination adherence**						
Mother's Education	0.285	0.066	4.31	0.000	0.155	0.415	Mother's Education	0.022	0.085	0.26	0.791	-0.143	0.188
Birth Order							Birth Order						
(2-3)	-0.080	0.077	-1.04	0.299	-0.232	0.071	(2-3)	-0.189	0.100	-1.88	0.060	-0.386	0.008
(4-6)	-0.102	0.091	-1.11	0.265	-0.281	0.077	(4-6)	-0.369	0.116	-3.18	0.001	-0.597	-0.141
(7+)	-0.268	0.138	-1.94	0.052	-0.539	0.003	(7+)	-0.531	0.157	-3.39	0.001	-0.838	-0.224
Mother's age at first birth							Mother's age at first birth						
(20-34)	0.257	0.082	3.12	0.002	0.095	0.418	(20-34)	0.354	0.102	3.46	0.001	0.153	0.554
(35+)	0.386	0.153	2.53	0.012	0.086	0.686	(35+)	0.412	0.183	2.25	0.024	0.053	0.770
Access to Antenatal Services	0.206	0.059	3.53	0.000	0.092	0.321	Access to Antenatal Services	-0.501	0.069	-7.24	0.000	-0.636	-0.365
Household Wealth Index							Household Wealth Index						
Second	0.135	0.087	1.55	0.121	-0.036	0.306	Second	0.044	0.089	0.5	0.620	-0.131	0.219
Middle	0.334	0.089	3.76	0.000	0.160	0.508	Middle	0.814	0.118	6.91	0.000	0.583	1.044
Fourth	0.301	0.086	3.52	0.000	0.133	0.469	Fourth	0.577	0.101	5.69	0.000	0.378	0.775
Richest	0.439	0.097	4.54	0.000	0.250	0.628	Richest	0.546	0.119	4.59	0.000	0.313	0.780
Constant	-0.828	0.090	-9.2	0.000	-1.004	-0.651	Constant	0.833	0.102	8.2	0.000	0.634	1.032
/athrho	0.737	0.06082	12.12	0	0.6177	0.85616							
rho	0.6273	0.03689			0.5496	0.69428							
Number of observation	2,101						Log pseudo-likelihood	-2093					
							Wald test of rho=0: chi2(1)	146.8					
Wald chi2(22)	239.85												
Prob> chi2	0.000						Prob> chi2	0.0000					

Source: Stataoutput based on MICS, (2014)

4.4 Estimation of Results

4.4.1. Polio Adherence Variable

To estimate the effect of immunisation adherence (Polio) in Bungoma County Kenya, the study utilized a bivariate probit model with robust standard errors. Marginal effects of the probit model on various independent variables were estimated for interpretation purposes. Findings are shown in Table 4.3. The study found a p-value of 0.000 which is less than 5% implying that the variables considered fit the model well, hence variables used in the model were jointly significant in explaining immunisation adherence (DTP or Polio) in Bungoma County.

The study results revealed an direct relationship between mother's education level and polio immunisation adherence. The variable had a z score value of 4.31 which is greater than z-tabulated of 1.96 at 5 percent level of significance hence implying that the variable is statistically significant. This is confirmed by a p-value of 0.000 which is below 0.05. Therefore, a unit increase in the mother's level of education will increase the likelihood of polio adherence by 0.285 holding other factors constant. This is in line with the notion that a mother's education is associated with polio adherence. There is an inverse relationship between polio adherence and birth order of the child. The variable had a z score values of -1.04, -1.11 and -1.96 respectively which are less than z-tabulated of 1.96 at 5 percent level of significance hence implying that the variable is statistically insignificant. This is confirmed by p-values of 0.299, 0.265 and 0.052 which are above 0.05. Therefore, a unit increase in the birth order from 2 to 3, 4 to 6 and 7+ will reduce the likelihood of polio adherence by -0.080, -0.102 and -0.268 respectively holding other factors constant. However, there is direct relationship between mother's age at first birth from 20 t0 34 and 35 and above. The variable had z score values of 3.12 and 2.53 respectively which are greater than z-tabulated of 1.96 at 5 percent level of significance hence implying that the variable is statistically significant. This is confirmed by a p-value of 0.002 and 0.012 which are below 0.05. Therefore, a unit increase in the mother's age at first birth from 20 t0 34 and 35 and above will increase the likelihood of polio adherence by 0.257 and 0.386 holding other factors constant.

Additionally, there is a positive relationship between polio adherence and access to antenatal service. The variable had a z score value of 3.53 which is greater than z-tabulated of 1.96 at 5 percent level of significance hence implying that the variable is statistically significant. This is confirmed by a p-value of 0.000 which is below 0.05. Therefore, a unit increase in the access to antenatal services will increase the likelihood of polio adherence by 0.206 holding other factors constant.

Household wealth index grouped in second middle, fourth and richest quartiles had a positive relationship with polio adherence. The second quartile was not statistically significant at 5 percent significance level since it had a z score value of 1.55 which is less than z-tabulated value of 1.96. This is confirmed by a p-value of 0.121. The middle, fourth and richest quartiles had z-score values of 3.76. 3.52 and 4.54 respectively which are greater than z-tabulated value of 1.96 implying that they were statistically significant at 5 percent significance level. These are confirmed by p-values of 0.000, 0.000 and 0.000 respectively which are below 0.05. Therefore, a unit increase in the household wealth index from second, middle, fourth and richest quartiles will increase the likelihood of polio adherence by 0.135, 0.334, 0.301 and 0.439 respectively holding other factors constant.

4.4.2 DTP Adherence Variable

To estimate the effect of immunisation adherence (DTP) in Bungoma County Kenya, the study utilized a bivariate probit model with robust standard errors. Marginal effects of the probit model on various independent variables were estimated for interpretation purposes. Findings are shown in Table 4.3. The study found a p-value of 0.000 which is less than 5% implying that the variables considered fit the model well, hence variables used in the model were jointly significant in explaining immunisation adherence (DTP or Polio) in Bungoma County.

The study results revealed an direct relationship between mother's education level and DTP adherence. The variable had a z score value of 0.26 which is less than z-tabulated of 1.96 at 5 percent level of significance hence implying that the variable is statistically insignificant. This is confirmed by a p-value of 0.791 which is above 0.05. Therefore, a unit increase in the mother's level of education will increase the likelihood of DTP adherence by 0.022 holding other factors constant. This is in line with the

notion that a mother's education is associated with DTP adherence. There is an inverse relationship between DTP adherence and birth order of the child. The variable had z score values of -3.18 and -3.39 respectively which greater than z-tabulated of 1.96 at 5 percent level of significance hence implying that the variable is statistically significant except birth order of 2 to 3 whose z-score value is below 1.96. This is confirmed by p-values of 0.001 and 0.001 which are above 0.05 except for birth order 2 to 3 which is 0.060. Therefore, a unit increase in the birth order from 2 to 3, 4 to 6 and 7+ will reduce the likelihood of DTP adherence by -0.189, -0.369 and -0.531 respectively holding other factors constant. However, there is direct relationship between DTP adherence and mother's age at first birth from 20 t0 34 and 35 and above. The variable had z score values of 3.46 and 2.25 respectively which are greater than z-tabulated of 1.96 at 5 percent level of significance hence implying that the variable is statistically significant. This is confirmed by a p-value of 0.001 and 0.024 which are below 0.05. Therefore, a unit increase in the mother's age at first birth from 20 t0 34 and 35 and above will increase the likelihood of DTP adherence by 0.354 and 0.412 holding other factors constant.

Additionally, there is a negative relationship between DTP adherence and access to antenatal service. The variable had a z score value of -7.24 which is greater than z-tabulated of 1.96 at 5 percent level of significance in absolute term hence implying that the variable is statistically significant. This is confirmed by a p-value of 0.000 which is below 0.05. Therefore, a unit increase in the access to antenatal services will reduce the likelihood of DTP adherence by 0.501 holding other factors constant. Household wealth index grouped in second middle, fourth and richest quartiles had a positive relationship with polio adherence. The second quartile was not statistically significant at 5 percent significance level since it had a z score value of 0.50 which is less than z-tabulated value of 1.96. This is confirmed by a p-value of 0.620. The middle, fourth and richest quartiles had z-score values of 6.91, 5.69 and 4.59 respectively which are greater than z-tabulated value of 1.96 implying that they were statistically significant at 5 percent significance level. These are confirmed by p-values of 0.000, 0.000 and 0.000 respectively which are below 0.05. Therefore, a unit increase in the household wealth index from second, middle, fourth and richest quartiles will increase the likelihood of DTP adherence by 0.044, 0.814, 0.577 and 0.546 respectively holding other factors constant.

Table 4. 4: Marginal Effects after Bivariate Probit Regression

y =Pr (polio=1,DTP=1) (predict)

= .37244459

Variable	dy/dx	Std. Err.	z	P>z	[95%	C.I.]	X
Mother's Education*	0.104	0.025	4.24	0.000	0.056	0.153	0.324
Birth Order	-0.030	0.014	-2.08	0.037	-0.058	-0.002	2.158
Mother's age at first birth	0.083	0.025	3.26	0.001	0.033	0.133	1.846
Access to Antenatal Services*	0.056	0.022	2.59	0.009	0.014	0.099	0.383
Household Wealth Index	0.043	0.008	5.45	0.000	0.027	0.058	2.861

(*) dy/dx is for discrete change of dummy variable from 0 to 1

As indicated in table 4.4, mother's education with a z-score value of 4.24 which is greater than z-tabulated value of 1.96 is statistically significant at 5 percent significance leve. This is confirmed by a p-value of 0.000 which is below 0.05. Household wealth index with a z-score value of 5.45 which is greater than z-tabulated value of 1.96 is statistically significant at 5 percent significance leve. This is confirmed by a p-value of 0.000 which is below 0.05. Mother's age at first birth with a z-score value of 3.26 which is greater than z-tabulated value of 1.96 is statistically significant at 5 percent significance leveL. This is confirmed by a p-value of 0.001 which is below 0.05. Birth order of the child with a z-score value of 2.08 which is greater than z-tabulated value of 1.96 is statistically significant at 5 percent significance leve. This is confirmed by a p-value of 0.037 which is below 0.05.

Access to antenatal services with a z-score value of 2.59 which is greater than z-tabulated value of 1.96 is statistically significant at 5 percent significance leveL. This is confirmed by a p-value of 0.009 which is below 0.05. This implies that these explanatory variables are important in determining the immunisation adherence (Polio and DTP) among under-five population. There is a positive association of mother's education with immunisation adherence hence a unit increase in mother's education increases the likelihood of immunisation adherence (Polio and DTP) by 0.104 holding other factors constant. This implies that the more educated a mother is, the higher the likelihood that she will adhere to immunisation schedule of her child. However, there is a negative relationship between child's birth order and immunisation adherence hence a unit increase in child's birth order will reduce the likelihood of adhering to

immunisation schedule by 0.030 holding other factors constant since there is a negative marginal effect. This is contrary to the nation that immunisation schedule should have adhered to no matter the child's birth order.

Mother's age at first birth is also positively related to immunisation adherence hence a unit increase in mother's age at first birth will increase the probability of adhering to immunisation schedule by 0.083 holding other factors constant. Access to antenatal services and household wealth index also have a positive relationship with immunisation adherence hence a unit increase in access to antenatal care and household wealth index increases immunisation adherence by 0.056 and 0.043 respectively.

4.4.3 Discussion of the study results

This sub-section discusses the study results in detail. The variable of interest is immunisation adherence (DTP and Polio) followed by the significant control variables and finally the non-significant control variables.

Findings are indicated in table 4.4. The study had a p-value of 0.000, which is less than 5% implying that variables considered best fit for the model; hence, variables used in the model were jointly significant in explaining immunization adherence of polio and DTP in Bungoma County.

Maternal education has been documented in several works of literature as a predictor of childhood immunization owing to changes in attitudes and traditions brought about by education, thus mothers with higher education levels are more likely to immunize their children (Birmeta et al., 2013; Forshaw et al., 2017; Njeru et al., 2019; Schoeps et al., 2013). This study agrees with our findings as the mother's level of education is seen to be statistically significant with a positive effect on Immunisation adherence (polio and DTP). Forshaw et al., (2017), states that a unit increase in the level of education of a mother increases both health care access and utilization which impacts positively on immunization adherence. Immunization is a critical factor to child survival and is known to prevent childhood morbidity and mortality thus a tool for demonstrating improved coverage.

Increased access and utilization of quality health care is demonstrated by improved coverage of under-five child health indicators as confirmed by our study. Mothers who receive antenatal care from medical practitioners are more likely to immunize their children than those who fail to go the routine medical check-up (Gurmu & Etana, 2016; Wiysonge et al., 2012; Njeru et al., 2019). This can be attributed to access and utilisation of educational messages from service providers on the need to adhere to the immunisation schedules thus improvement in immunisation adherence.

Household wealth index was found to be statistically significant in influencing immunisation adherence (Polio and DTP). Similar studies carried out in Kenya and Ethopia have demonstrated that utilisation of health services decreases as the family income gets lower (Maina et al.,2017, 2014; Birmeta et al., 2013). This is agress with similar studies done by (Wiysonge et al., 2012; Schoeps et al., 2013; Gram et al., 2014), in their studies, their argument that mother's in poorest and second poorest quartile are either more likely or less likely to immunize their children against DPT and Polio owing to possible financial constraints incurred in maximizing their utility functions.

As the woman matures, they are more likely to immunize their children compared to teenage mothers, they are more informed about immunisation services both from experience, family, friends and through other channels such as social media (Gibson et al., 2015; Njeru et al., 2019). This is in line with our study findings which shows that mother's age at first birth is statistically significant and increases the probability of a child being immunized against DTP or Polio holding other factors constant.

Ordinarily one would expect that children born in the later years will be likely more to be immunized than the firstborn as the mother is more informed on the importance of immunisation (Schoeps et al., 2013). This has been disputed with our results which shows that higher birth order is unlikely to be immunized.

5.0 CHAPTER FIVE: SUMMARY, CONCLUSION AND POLICY IMPLICATIONS

5.1 Introduction

This chapter reflects study results, discusses policy contributions between immunization and child health outcomes. In addition, launches a more detailed discussion on areas for further research to be considered in future.

5.2 Summary of the study findings

Notwithstanding the numerous attempt by the Kenya government to improve immunisation adherence, the Bungoma County still lags behinds for coverage of basic vaccines. The continuous downward trends in immunisation coverage indicate challenges for a sustained solution. This study, therefore, was conducted with two main objectives that are to determine the determinants of immunisation adherence in Bungoma County, secondly establish effects of mother's level of education on immunisation adherence.

The study employed descriptive analysis and targeted 2,101 children under – five years old from Bungoma County, MICS 2014. Information on immunisation history of the child was found from a child's immunisation card and verbal explanation from the mother. Information on DTP adherence was at 81% while polio adherence was at 42%.

The study conducted a probit regression test to estimate immunisation adherence where maternal education was found to be significant on DTP but in a negative way but in Polio although its effect is negative, there was no association. The significance was tested at 1%, 5% and 10% levels. A probit regression model was used in estimation. The dependent variable used was DTP and Polio antigen respectively while the independent variable of interest was education level of the mother, birth oder of the child, mother's age at first birth, access to antenatal care and household wealth index.

Findings from the study concluded that each of the independent variables is statistically significant to immunisation adherence (Polio and DTP). These findings provide insights to the underlying cause of failure to achieve the WHO immunization coverage across the county at 80% and 90% at national level.

5.3 Conclusions of the study findings

Several studies have been conducted on immunisation adherence as a conduit for achieving UHC. Due to persistent disparities and inequities across regions, there is a need to conduct specific regional analysis on immunisation adherence. The study findings recommend to context-specific intervention to improving coverage in light of scarce resources available at national and devolved units in Kenya.

5.4. Policy Suggestions

For Kenya to achieve vision 2030, it has to improve and sustain coverage and equity of immunisation programmes in all of its regions. Based on study findings, the study points out that in order to achieve optimal immunization coverage, public health programmes should aim at empowering women as primary caregivers to increase utilization of service provided. This will empower mothers in decisions such as understanding the importance immunization.

The government should work on improving regional disparities related to immunisation and UHC agenda. The existing policy should consistently be reviewed to reflect the government commitment in achieving universal health coverage.

5.5. Areas of further study

The study concentrated on effect of mother's education on immunization adherence in Bungoma County in reference to specific antigen i.e. Polio and DTP using county cross-sectional data set. Future studies may consider applying panel or time-series datasets, within either the county or comparison across selected counties, incorporating qualitative approach. After the promulgation of the new constitution, health services have been developed. Counties have performed differently in terms of achieving optimal immunization coverage, further research can be applied to understand country-specific challenges and cross-cutting challenges that can be addressed. Although current study has applied more of quantitative analysis and with specific antigen, areas for further research can apply qualitative approach with the entire recommended WHO antigen.

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